

Risk Assessment Model -- Calculation of Potential Risks from Consumption of Human Milk**Chemical Parameter Values**

Chemical	Slope Factor SFo (mg/kg/day)-1	Intermediate MRL (mg/kg/day)	Chronic RfD (mg/kg/day)	Half-life h (days)	Kelim (days^-1)	Kelac (days^-1)	Concentration in Fish (Cf) (mg/kg)
PCB-153		0.00003	0.00002	10,038	6.91E-05	1.85E-03	5.65 (ug/kg)
PCB	2	0.00003	0.00002	2555	2.71E-04	2.05E-03	1
2,3,7,8-TCDD	1.5E+05	2.00E-08	1.00E-09	2555	2.71E-04	2.05E-03	0.00001
DDD	0.24			120	5.78E-03	7.56E-03	1
DDE	0.34			120	5.78E-03	7.56E-03	1
DDT	0.34	0.0005	0.0005	120	5.78E-03	7.56E-03	1

Exposure and Risk Calculations

Chemical	Mother ADDm (mg/kg/day)	Mother DAimat (mg/kg/day)	Average Milk Conc. Cmf (mg/kg-lipid)	Infant ADDca-i (mg/kg/day)	Infant ADDnc-i (mg/kg/day)	Non-Cancer Infant/Mother Exposure Ratio	Excess Lifetime Cancer Risk	Cancer Infant/Mother Risk Ratio	Hazard Quotient	Non-Cancer Infant/Mother Risk Ratio
	Mother ELCRm	Infant ELCRI	Mother HQm	Infant HQi						
PCB-153 (ug)	0.001498	0.001498	19.40	1.4E-03	9.7E-02	65			0.075	3.2
PCB	0.000265	0.000265	1.89	1.4E-04	9.5E-03	36	2.3E-04	2.7E-04	1.20	13
2,3,7,8-TCDD	2.7E-09	2.7E-09	1.9E-05	1.4E-09	9.5E-08	36	1.7E-04	2.0E-04	1.20	3
DDD	0.000265	0.000265	0.12	8.3E-06	5.8E-04	2.2	2.7E-05	2.0E-06	0.073	5
DDE	0.000265	0.000265	0.12	8.3E-06	5.8E-04	2.2	3.9E-05	2.8E-06	0.073	1.8
DDT	0.000265	0.000265	0.12	8.3E-06	5.8E-04	2.2	3.9E-05	2.8E-06	0.073	0.530
									1.17	2.2

Approximate Relative Adjustment Factors

Chemical	Steady State Cmf (mg/kg-lipid)	Non-Steady State Factor	Mass Loss Through BF Factor	Combined Factor	Approximate Cmf (mg/kg-lipid)	Full Calculation Cmf (mg/kg-lipid)
PCB-153 (ug)	65.1	0.396	0.727	0.29	18.7	19.4
PCB	2.93	0.862	0.704	0.61	1.78	1.89
2,3,7,8-TCDD	2.9E-05	0.862	0.704	0.61	1.78E-05	1.89E-05
DDD	0.14	1.000	0.340	0.34	0.047	0.116
DDE	0.14	1.000	0.340	0.34	0.047	0.116
DDT	0.14	1.000	0.340	0.34	0.047	0.116

Calculated values

ADDm mg/kg/day Average Daily Dose to mother
 DAimat mg/kg/day Daily Absorbed Intake to mother
 Cmf mg/kg-lipid Chemical concentration in milkfat - Avg over 1 year of BF
 ADDca-i mg/kg/day Average Daily Dose to breast-feeding infant, cancer
 ADDnc-i mg/kg/day Average Daily Dose to breast-feeding infant, non-cancer
 ELCRm risk Excess Lifetime Cancer Risk to mother
 ELCRI risk Excess Lifetime Cancer Risk to infant
 HQm quotient Hazard Quotient to mother
 HQi quotient Hazard Quotient to infant

Note: Acceptable levels are ELCR = 1E-6 and HQ = 1

Equations

$$\text{ADDm} = (\text{Cf} \times \text{IRf} \times \text{Conv} \times \text{Ffc}) / \text{BWmat}$$

$$\text{DAimat} = \text{ADDm} * \text{AEmat}$$

$$\text{Cmf} = (\text{DAimat} * \text{Ff} / \text{Kelim} / \text{Ffm}) * (\text{Kelim} / \text{Kelac} + 1 / (\text{Kelac} * \text{Tbf})) * (1 - e^{(-\text{Kelim} * \text{Tpn})}) - \text{Kelim} / \text{Kelac} * (1 - e^{(-\text{Kelac} * \text{Tbf})})$$

$$\text{ADDca-i} = (\text{Cmf} * \text{Fbmb} * \text{IRmilk} * \text{EDinf}) / (\text{BWinf} * \text{ATc})$$

$$\text{ADDnc-i} = (\text{Cmf} * \text{Fbmb} * \text{IRmilk} * \text{EDinf}) / (\text{BWinf} * \text{ATinf})$$

$$\text{ELCRm} = \text{ADDm} * \text{SFo} * 30 / 70$$

$$\text{ELCRI} = \text{ADDca-i} * \text{SFo}$$

$$\text{HQm} = \text{ADDm} / \text{RfD}$$

$$\text{HQi} = \text{ADDnc-i} / \text{MRL}$$

Default Values

h	chemical specific	days	Chemical halflife
Kelim	chemical specific	1/day	Total elimination rate constant for non-lactating women
Kelac	chemical specific	1/day	Total elimination rate constant for lipid phase during nursing
SFo	chemical specific	(mg/kg/day)-1	Slope Factor - oral
MRL	chemical specific	mg/kg/day	Minimum Risk Level from ATSDR
RfD	chemical specific	mg/kg/day	Reference Dose - oral
IRf	17.5	g/day	Mother's ingestion rate of fish
Conv	0.001	kg/g	Conversion factor
AEmat	1	fraction	Absorption rate of chemical in mother
Ffc	1	fraction	Fraction of fish contaminated
Ff	0.9	fraction	Fraction maternal chemical stored in fat
Ffm	0.3	fraction	Fraction of maternal BW that is fat
Fmbm	0.04	fraction	Fraction of fat in milk
Tbf	365	days	Duration of breast feeding
Tpn	7300	days	Duration of mother's exposure prior to birth
BWmat	66	kg	Body weight mother
BWinf	7.8	kg	Body weight infant
IRmilk	0.98	kg/day	Ingestion rate of milk
EDinf	365	days	Exposure duration infant
ATinf	365	days	Averaging time infant - noncancer = EDinf
ATc	25550	days	Averaging time for carcinogenic effects

Table 1
Comparison of PCB-153 Concentrations in Milk Calculated from EPA Model, Haddad Model, and Yang Model

Subject ID	Dose to Mother ADDm (ug/kg/day)	EPA		6-Month Average Milk Concentration			6-Month Concentration Ratios			1-Year Average Milk Concentration			1-Year Concentration Ratios		
		Initial Milk Concentration (ug/kg-lipid)	(ug/kg-lipid)	EPA (ug/kg-lipid)	Haddad (ug/kg-lipid)	Yang (ug/kg-lipid)	EPA Haddad	EPA Yang	Haddad Yang	EPA (ug/kg-lipid)	Haddad (ug/kg-lipid)	Yang (ug/kg-lipid)	EPA Haddad	EPA Yang	Haddad Yang
236	0.0015	65		22	14	31	1.59	0.73	0.46	19	13	19	1.52	1.02	0.67
265	0.0039	168		57	50	82	1.16	0.70	0.61	50	48	51	1.05	0.98	0.93
159	0.0057	248		85	53	125	1.59	0.68	0.43	74	50	74	1.49	1.00	0.67
55	0.0064	278		95	98	132	0.97	0.72	0.74	83	89	82	0.93	1.01	1.09
199	0.0075	326		111	79	150	1.42	0.74	0.52	97	72	94	1.34	1.03	0.77
222	0.0088	384		131	137	177	0.96	0.74	0.78	115	135	109	0.85	1.05	1.24
93	0.0154	667		228	153	310	1.49	0.74	0.49	199	135	194	1.47	1.02	0.70
210	0.0337	1466		501	463	683	1.08	0.73	0.68	437	456	428	0.96	1.02	1.07

Notes:

Dose to Mother from Haddad simulations9 28 09.xls

Haddad 6-month and 1-year averages from Haddad simulations9 28 09.xls

Yang 6-month and 1-year values (not averages) from report_for_oregon_request.xls

EPA calculation of average milk concentration: $Cmf = (DAImat \cdot Ff / Kelim \cdot Ffm) (Kelim / Kelac + 1 / (Kelac \cdot Tbf6)) * (1 - e^{-(-Kelim \cdot Tpn)} - Kelim / Kelac) * (1 - e^{-(-Kelac \cdot Tbf6)})$

Table 2
Comparison of PCB-153 Doses to Infant Calculated from EPA Model, Haddad Model, and Yang Model

Subject ID	Dose to Mother ADDm (ug/kg/day)	EPA		(Using Milk Concentration at 3 Months)			6-Month Dose Ratios			1-Year Average Dose to Infant			1-Year Dose Ratios		
		Initial Milk Concentration (ug/kg-lipid)	(ug/kg-lipid)	EPA (ug/kg-BW/Day)	Haddad (ug/kg-BW/Day)	Yang (ug/kg-BW/Day)	EPA Haddad	EPA Yang	Haddad Yang	EPA (ug/kg-BW/Day)	Haddad (ug/kg-BW/Day)	Yang (ug/kg-BW/Day)	EPA Haddad	EPA Yang	Haddad Yang
236	0.0015	65		0.112	0.064	0.153	1.75	0.73	0.42	0.098	0.049	0.096	1.99	1.02	0.51
265	0.0039	168		0.289	0.227	0.412	1.27	0.70	0.55	0.252	0.181	0.258	1.39	0.98	0.70
159	0.0057	248		0.425	0.244	0.627	1.74	0.68	0.39	0.371	0.189	0.369	1.97	1.00	0.51
55	0.0064	278		0.478	0.448	0.661	1.07	0.72	0.68	0.417	0.342	0.412	1.22	1.01	0.83
199	0.0075	326		0.559	0.359	0.753	1.56	0.74	0.48	0.488	0.276	0.472	1.77	1.03	0.58
222	0.0088	384		0.660	0.627	0.887	1.05	0.74	0.71	0.576	0.506	0.547	1.14	1.05	0.92
93	0.0154	667		1.145	0.699	1.558	1.64	0.74	0.45	0.999	0.522	0.976	1.91	1.02	0.54
210	0.0337	1466		2.516	2.110	3.430	1.19	0.73	0.62	2.196	1.709	2.149	1.28	1.02	0.80

Notes:

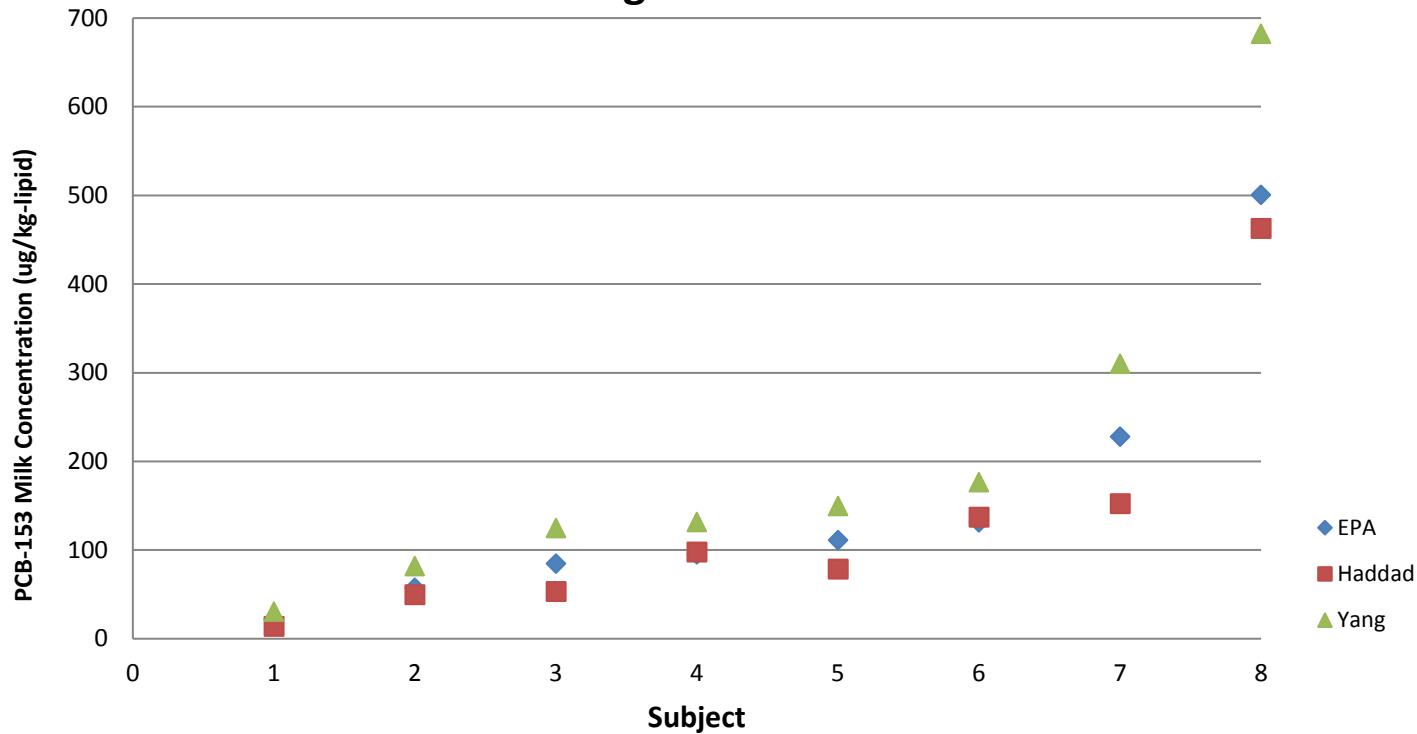
Dose to Mother from Haddad simulations9 28 09.xls

Haddad 6-month and 1-year averages from Haddad simulations9 28 09.xls

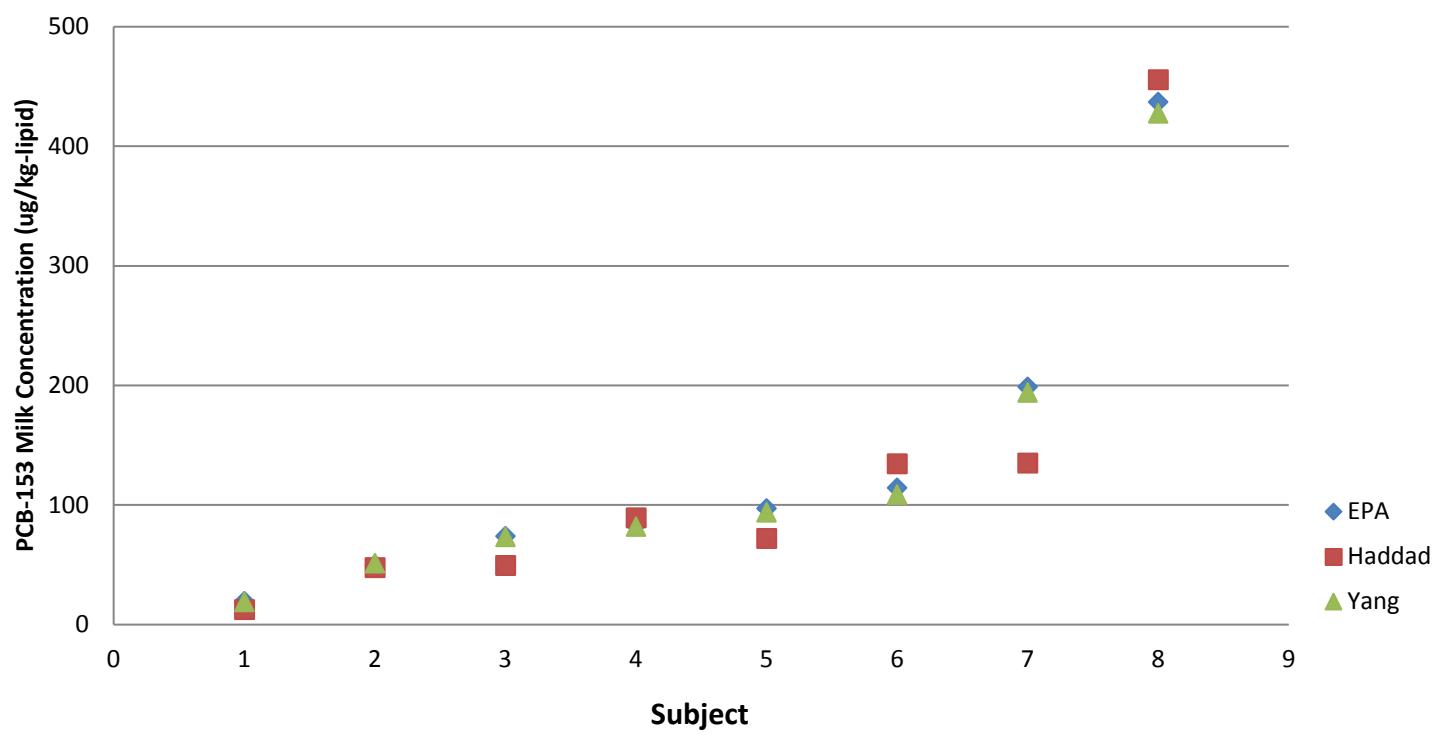
Yang 6-month and 1-year values calculated from final (not initial) concentration (from report_for_oregon_request.xls) using EPA equation.

EPA calculation of average dose to infant: $ADDnc-i = (Cmf \cdot Fbmb \cdot IRmilk \cdot EDinf) / (BWinf / ATinf)$

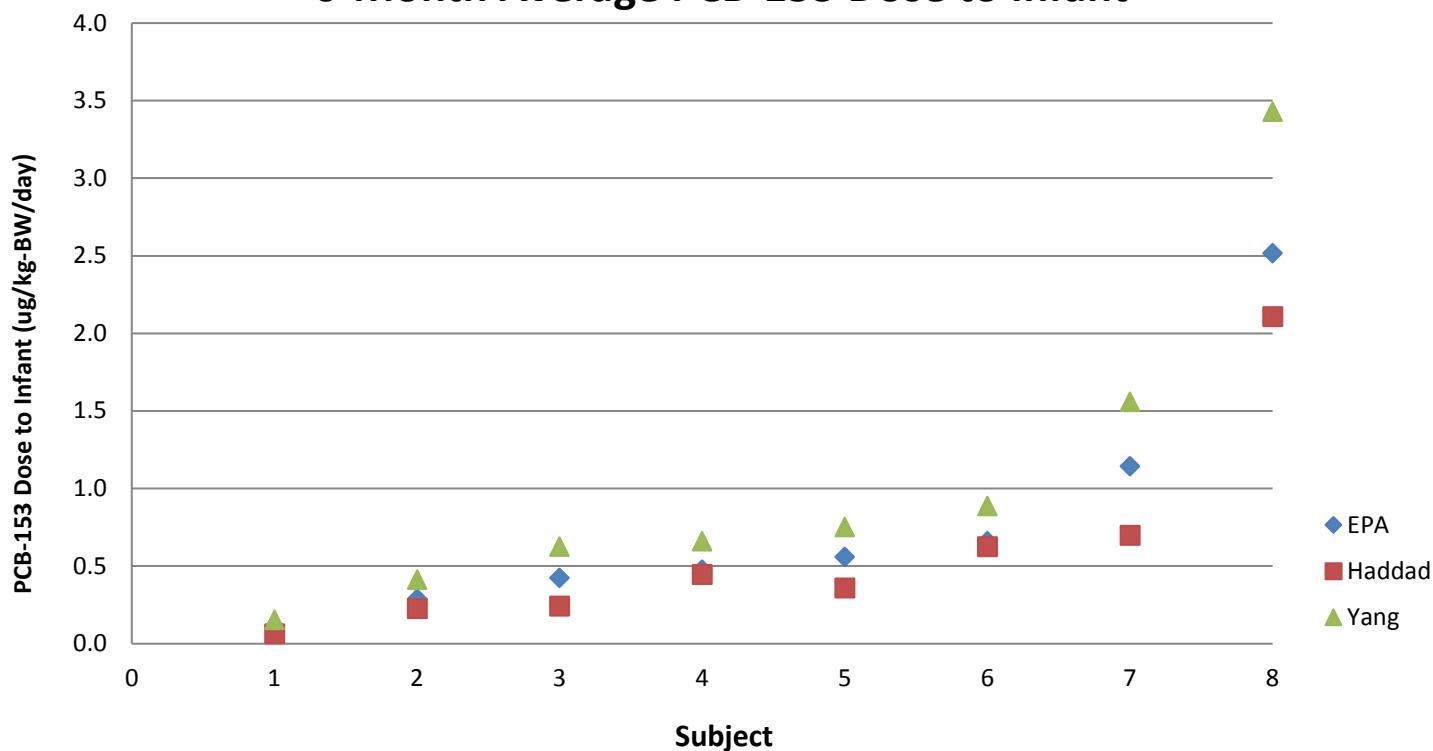
Model Comparison 6-Month Average PCB-153 Milk Concentrations



Model Comparison 1-Year Average PCB-153 Milk Concentrations



Model Comparison 6-Month Average PCB-153 Dose to Infant



Model Comparison 1-Year Average PCB-153 Dose to Infant

